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Monetary Policy and Credit in China: a Theoretical Analysis

by

John Bennett and Huw D Dixon

Department of Economics and Related Studies
University of York
Heslington
York, YO10 5DD

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John Bennett
Swansea University
j.s.bennett:@swansea.ac.uk

and

Huw Dixon
University of York
York YO1 5DD
hdd1@york.ac.uk

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Abstract

A three-sector macro model of the Chinese economy is developed in which the activity of state-owned enterprises (SOEs) is constrained by the state-imposed credit plan for working capital. Our analysis indicates the weaknesses of credit control and nominal interest rate increases as tools for holding down the price level; but the hardening of SOEs' budget constraints is found to be an effective device. The existence of credit and currency controls tends to make devaluation contractionary. Because of general equilibrium repercussions, policies that boost industrial exports tend to reduce welfare in the agricultural sector, where poverty is concentrated.

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Monetary Policy and Credit in China: a Theoretical Analysis

The development of substantial elements of a market system in the real sector in China over the past two decades has been accompanied by a tendency to high inflation, which the authorities have combatted primarily by monetary policy.[1] However, commercial banking in China, which is dominated by four large state-owned banks, remains subject to the type of controls associated with central planning, with the main instrument of monetary control being the quantitative regulation of credit via the "credit plan".[2] The PBC formulates the credit plan with the active collaboration of the Ministry of Finance and the State Planning Commission (SPC). As a result particularly of the participation of the SPC, the credit plan is not only the main method of control of the money supply; it is also a means by which more microeconomic objectives are pursued. Detailed priorities are set for "policy lending", which, in some cases, is even specified at the level of the individual borrower. In part, policy lending is employed to support chosen growth sectors, but it is also used to underpin loss-making SOEs. Consequently, a large proportion of bank loans are non-performing.[3] Many loans are effectively subsidies extended under government direction (blurring the distinction between monetary and fiscal policy), while often the banks themselves concede parts of loans to ensure SOEs' survival (World Bank, 1996; Zou and Sin, 1996).

In this paper we focus on the role of working capital, which is a particularly important component of the credit plan, being a priority item (Montes-Negret, 1995) and constituting about 60% of planned loans (World Bank, 1996). We develop a three-sector model in which agriculture is modelled as a single sector, but industry is split into two sectors, which produce a non-traded good and an export good, respectively.[4] For simplicity, the non-traded industrial good producing sector is assumed to be composed entirely of SOEs, for whom output is constrained by the availability of credit for working capital.[5] Also, we allow for SOEs having soft budget

constraints, by assuming that a portion of the loans in this sector is not repaid to the banks. In contrast, the export sector is treated as facing no limits on the availability of credit for working capital. This is intended as a stylized representation of the priority that is given to exports in the credit plan (Montes-Negret, 1995). However, during periods of severe credit tightening, the difficulties encountered by SOEs have led the authorities to override other priorities and give the SOEs a larger proportion of the credit available.[6] We therefore also modify the model to allow for credit rationing to the export sector. Throughout, the simplifying assumption is made that agriculture has no working capital needs.

Because of the complex mix of plan and market in China and the variety of institutional forms under which production takes place, any stylized model of the Chinese economy should be treated with caution. Nonetheless, we believe that our analysis indicates the importance of attempting to model the specific features of the Chinese economy, for we obtain results about the effects of monetary policy that are quite different to those obtaining in a free-market economy. We find that credit controls have an effect on the aggregate price level that can take either sign, while an increase in the nominal interest rate leads to a higher aggregate price level. Furthermore, monetary expansion (in the sense of greater initial money balances for households) has an overall contractionary effect on output. A similar conclusion may apply for devaluation. These results are due to the general equilibrium repercussions of the credit plan and the control of foreign currency.

In Section 1 we set up the basic model. In Section 2 we characterize the macroeconomic equilibrium, while in Section 3 we examine various policy changes. We pay particular attention to variation of the credit plan, and we go on to consider a change in the nominal interest rate and a hardening of the budget constraint for SOEs. We also look at various other policy charges, including devaluation. In Section 4 we consider briefly the effect of the imposition of credit rationing on the export sector. In Section 5 we summarize our main conclusions and discuss their

implications.

1 THE MODEL

The Utility Function

Our formulation of the utility function is similar to that of Blanchard and Kiyotaki (1987), and Ball and Romer (1990), amongst others.[7] We consider a single period, for which any household h has the utility function

$$u_h = \text{ø}(F_h^{\text{á}}Q_h^{1-\text{á}})^c(M_h/P)^{1-c} - N_h^{\text{ä}}/\text{ä} \qquad 0<\text{á}<1, \quad 0<c<1, \quad 1<\text{ä} \tag{1}$$

where $\text{ø}^{-1}=\text{á}^{\text{á}}(1-\text{á})^{1-\text{á}}c^{\,c}(1-c)^c$; F_h and Q_h are h's consumption of food and the non-traded industrial good, respectively; M_h is its terminal money holding and N_h is the amount of time it spends working. P is the cost-of-living index associated with the Cobb-Douglas sub-utility function in goods:

$$P = p_F^{\text{á}}p_Q^{1-\text{á}} \tag{2}$$

where p_F and p_Q are the respective money prices of food and the non-traded industrial good. c in eq.(1) is h's average (= marginal) propensity to consume.

We shall consider three types of household, using the subscripts $h=F,Q,X$ for a household working in the agricultural, non-traded industrial good and export sectors, respectively. We define imputed income y_h as initial money holding M_h^o plus the relevant measure of h's earnings. This measure will be defined separately below for each of $h=F,Q,X$. The budget constraint facing h is

$$p_F F_h + p_Q Q_h + M_h \leq y_h, \qquad h=F,Q,X \tag{3}$$

Maximising u_h w.r.t. (3) yields

$$F_h = \text{á}cy_h/p_F$$

$$h=F,Q,X \tag{4}$$

$$Q_h = (1-\text{á})cy_h/P_Q$$

The Agricultural Sector

The disadvantages associated with migration confine the number of households in the agricultural sector to L_F.[8] The representative household in this sector produces an amount of food A_F according to the production function

$$A_F = N_F^a, \qquad 0<a<1 \tag{5}$$

The household retains the amount of food F_F for its own consumption (by assumption, $F_F<A_F$); but its imputed income y_F includes the entire market value of its output:

$$y_F = M_F^o + p_F A_F \tag{6}$$

The agricultural household is a price-taker; both p_F and p_Q are market-clearing. Given (2), (3), (5) and (6), its utility-maximizing input of labour time is

$$N_F = \left[a \left(\frac{p_F}{p_Q} \right)^{1-á} \right]^{1/(ä-á)} \tag{7}$$

N_F is increasing in the terms of trade p_F/p_Q. A_F, F_F, Q_F and y_F then follow from (3)-(6).

The Non-Traded Industrial Good Sector

This sector consists of SOEs.[9] In modelling the representative SOE we wish to highlight three particular factors. The first is that SOEs in practice have operated with a rate of disguised unemployment reported to be 15-20% (Hussain, 1992; World Bank, 1997). Second, we want to show the dependence of SOEs on the credit plan, in particular for working capital. Third, we wish to represent the failure of SOEs to honour their full debt obligations (this is associated with the soft budget constraint). We therefore model the representative SOE as having a parametrically fixed number of employees L_Q,[10] where L_Q exceeds current production needs. The SOE produces output Q and uses I_Q of an imported intermediate. Its production function is Leontief, where, for consistency of our formulation across all three sectors, we assume that

there are diminishing returns in the labour contribution:

$$Q = \min(L_Q^{\hat{a}}, I_Q), \qquad 0<\hat{a}<1 \tag{8}$$

The credit plan specifies that working capital up to the amount M_Q may be advanced to the SOE at the nominal interest rate *r*. As will become clear from our formulation of SOE worker income, the SOE will always choose to borrow the full amount available. Also, we assume that M_Q is used entirely to buy intermediates, rather than any of it being distributed directly to workers. (The case of direct distribution of part of M_Q is already captured in the model, for it is equivalent to a higher level of the initial household money holding M_Q^o. We return to this issue in Section 4.) Hence, as there is surplus labour in the firm,

$$L_Q^{\hat{a}} > Q = I_Q = M_Q/p_I \tag{9}$$

The managers of SOEs in practice tend to collude with their labour force to avoid centrally-imposed restrictions on wage scales (see Hussain and Stern, 1991; Qian, 1995). Given, also, that, with all households possessing utility function (1), changes in the distribution across households of a given total income have no effects on goods demands, little is therefore lost if we model the representative SOE as distributing to its workforce all of its net revenue. In calculating this net revenue, however, we take into account that the SOE only honours the proportion ö of its debt, $(1+r)M_Q$. Thus, each employee receives

$$W_Q = \frac{1}{L_Q}\left[p_Q Q - \ddot{o}(1+r)M_Q - T_Q\right], \qquad 0 \le \ddot{o} \le 1 \tag{10}$$

where T_Q is the tax paid by the SOE. Substituting from (8) and (9) into (10),

$$W_Q = \frac{1}{L_Q}\left\{\left[\frac{p_Q}{p_I} - \ddot{o}(1+r)\right] M_Q - T_Q\right\} \tag{11}$$

We assume that the firm is a price-taker; p_Q is market-clearing.[11] For simplicity, we treat ö as constant, a larger ö implying a harder budget constraint. The microeconomic and institutional factors that determine the hardness of the budget constraint are beyond the scope of this paper.[12]

Finally, imputed income for $h=Q$ is simply

$$y_Q = M_Q^o + W_Q \tag{12}$$

The *Q*-household maximizes u_Q subject to (12), treating W_Q as a parameter.

The Export Sector

China's exports come from enterprises of various institutional forms, including township and village enterprises (TVEs), joint ventures and more profit-oriented SOEs. In all these enterprises it is generally easier to fire workers than it is in traditional SOEs.[13] We therefore model the representative export sector firm as choosing freely its purchase of the services of L_X workers at the going wage. Also, since, in practice, priority is given to exporters in the credit plan, we assume that the amount of working capital M_X that the firm can borrow is unconstrained. This working capital is used to purchase I_X of imported intermediates.[14] The firm produces output *X* according to the production function[15]

$$X = \min(L_X^b, I_X), \qquad 0<b<1 \tag{13}$$

As there are no binding constraints on its behaviour,

$$L_X^b = X = I_X = M_X/p_I \tag{14}$$

Since the bad debt problem in China is largely confined to traditional SOEs, we make the simplifying assumption that the export sector firm always repays its debt fully. After-tax profit is hence $Ð_X = p_X X - W_X L_X - p_I I_X - rM_X - T_X$, where p_X is the unit price of exports in domestic currency, W_X is the market wage rate (in nominal terms) and T_X is the amount of tax paid by the firm. Using (14), we therefore have

$$Ð_X = \left[p_X - (1+r)p_I\right] L_X^b - W_X L_X - T_X \tag{15}$$

Maximising (15) with respect to L_X, given that $p_X - (1+r)p_I > 0$, yields

$$L_X = \left\{\frac{b[p_X - (1+r)p_I]}{W_X}\right\}^{\frac{1}{1-b}} \tag{16}$$

Given the utility function (1), the identity of the recipients of $Ð_X$ is of no significance for the

macro equilibrium, provided that all of $Đ_X$ goes to domestic residents.[16] For simplicity, we assume that $Đ_X$ is shared equally between the L_X workers in the firm. Thus, imputed income is

$$y_X = M_X^o + W_X + Đ_X/L_X \tag{17}$$

Each employee is assumed to treat $Đ_X/L_X$ as a parameter.

The Labour Market

Open unemployment is $U=H-L_F-L_Q-L_X$, where H denotes the total number of households. We treat both L_F and L_Q as given, whereas L_X is determined in a competitive labour market. The rationale for this assumption is the existence in China of a 'floating population' of 100-150m. wandering in search of work (Sachs and Woo, 1997). Normalizing the number of hours in the work period in the X sector to unity, $N_X=1$ in eq.(1), and so the disutility of working for the day is $1/ä$. Assuming that $U>0$, the real wage for the work period is driven down to this disutility:

$$W_X/P = 1/ä \tag{18}$$

International Trade

China's foreign exchange system has now reached an unprecedented uniformity (Boke, 1996) and so we assume that imports of the intermediate, I_Q+I_X, and exports, X, occur at world prices, p_I^* and p_X^* respectively, mediated by the official exchange rate e:

$$p_I = ep_I^*$$

$$p_X = ep_X^* \tag{19}$$

At the same time, China retains a complex import control system, with the main priority being imports of inputs. Recently, however, there has been a shift in the composition of imports toward food, reflecting the government's desire to reduce the pressure on food prices (World Bank, 1996).[17] The government pays the foreign currency world unit price p_F^* for food and then

releases it on to the domestic market. Since the government's active control of domestic goods prices has declined substantially in the 1990s, we assume that the domestic food price p_F is market-clearing; the injection of imports of food by the government is merely a rightward shift in the supply curve.

National Income Accounts

We reflect China's import management system by assuming that the balance of trade in foreign currency, B^*, is a policy parameter. We have already specified I_Q, I_X and X as endogenous, but we now further assume that the government allows in imports of food A^M insofar as the balance of trade constraint allows. We therefore have

$$B^* = p_X^* X - p_I^* (I_Q + I_X) - p_F^* A^M \tag{20}$$

where A^M is determined as a residual, which we assume throughout is positive.[18] We define the nominal budget deficit as

$$D = -T + (ep_F^* - p_F)A^M - \{rM_X + [1 - \ddot{o}(1+r)]M_Q\} \tag{21}$$

where $T = T_Q + T_X$. The term $(ep_F^* - p_F)A^M$ is the subsidy to the domestic food market from the government buying at the foreign currency world price p_F^* and selling domestically at p_F. The term in curly brackets, the profit of the commercial banking sector (which may be negative), is included because commercial banking is not so much an industry as an arm of government in China.[19] Its inclusion makes our definition of *D* close to what is known as the 'consolidated government deficit'. Since money creation has been the main form of financing of the consolidated government deficit in practice (Clutterbuck, 1992; World Bank, 1995), we make the simplifying assumption that *D* is financed entirely by money creation.

Let *Y* denote nominal national income. Using the fact that, from (1), *c* is the average propensity to consume, standard manipulations now yield

$$Y = \frac{c}{1-c}(M^o + D) + B \tag{22}$$

where $M^o \equiv L_F M_F^o + L_Q M_Q^o + L_X M_X^o$ and $B \equiv eB^*$. Hence, Y is determined by a standard income-expenditure process. Note that Y depends only on policy parameters, not on what happens to prices and quantities.

Using the Cobb-Douglas subutility function (see eq.(1)), aggregate household expenditure $c(Y+M^o)$ divides between food and the non-traded industrial good in the proportions á and $1-$á, respectively. Thus,

$$\begin{aligned} p_F F^d &= \text{á} c(Y+M^o) \\ p_Q Q^d &= (1-\text{á}) c(Y+M^o) \end{aligned} \tag{23}$$

where $F^d \equiv L_F F_F + L_Q F_Q + L_X F_X$ is total food demand and $Q^d \equiv L_F Q_F + L_Q Q_Q + L_X Q_X$ is the total demand for non-traded goods.

2. MACROECONOMIC EQUILIBRIUM

Given that the markets for food, non-traded industrial goods and export sector labour all clear, the equilibrium for this system can be expressed in three equations. First, we take the market-clearing condition for food, $F^d - L_F A_F - A^M = 0$, and, using (5), (7), (9), (14), (19), (20) and (23), we obtain

$$\frac{\text{á} c(Y+M^o)}{p_F} - L_F \left[a \left(\frac{p_F}{p_Q} \right)^{1-\text{á}} \right]^{\frac{a}{\text{ä}-a}} - \frac{1}{p_F^*} \left[(p_X^* - p_I^*) X - \frac{M_Q}{e} - B^* \right] = 0 \tag{24}$$

Similarly, for the non-traded industrial good, we substitute into $Q^d - Q = 0$ from (9), (19) and (23), yielding

$$\frac{(1-\text{á}) c(Y+M^o)}{p_Q} - \frac{M_Q}{e p_I^*} = 0 \tag{25}$$

Finally, for the labour market in the export sector, we use (2), (14), (16) and (18) to obtain

$$be[p_X^* - (1+r) p_I^*] X^{\frac{b-1}{b}} - \frac{p_F^{\text{á}} p_Q^{1-\text{á}}}{\text{ä}} = 0 \tag{26}$$

There are three endogenous variables in (24)-(26): p_F, p_Q and X. Once the solution to (24)-(26) is obtained, the equilibrium values of other variables are easily found from the rest of the model.

In the next section we consider the comparative statics of the system (24)-(26). The assumptions on which this discussion is based are specified in the Appendix. First, we assume throughout that a standard stability assumption is satisfied. Second, in the case of some of the results that are found to be ambiguous in sign, we find that the introduction of a further assumption yields clear-cut signs. This further assumption, which is essentially a condition that direct impacts of certain parameter changes dominate the indirect repercussions, is specified in the Appendix, where it is denoted condition (A2).

3. POLICY CHANGES

As noted in the introduction, the general equilibrium interactions between the operation of the credit plan and the control of foreign currency yield effects that contrast sharply with those generally found in models of free market economies. This can be seen from the comparative statics of the model, which are set out in Table 1. The left-hand column shows the parameters that are varied, while the top row shows the most important endogenous variables that may be affected. The signs in parentheses are those for which we assume that condition (A2) is satisfied in order to get a determinate sign.

[TABLE 1 ABOUT HERE]

The first parameter change shown is variation of the amount of working capital M_Q allowed by the credit plan for the non-traded industrial good sector. According to the OECD (1996) tight credit controls from the end of 1993 provoked a sharp real contraction. Our model tends to support this view, though some signs are indeterminate in this case. A higher level of M_Q enables the non-traded industrial good sector to buy more intermediates I_Q, thereby raising

output Q. Furthermore, the immediate impact on domestic food output is also positive because the terms of trade p_F/p_Q facing domestic food producers is improved. This occurs for two reasons. The first is that the higher level of Q has a negative impact on price p_Q. Secondly, the higher level of intermediates imports I_Q is associated with a reduction in imports of food A^M, and this has a positive impact on the domestic food price p_F.

Some indeterminacy arises in the first row of Table 1, however, because of general equilibrium repercussions through exports X. Since the variations of p_F and p_Q described above are in opposite directions, the net effect on the price index P may be of either sign, as consequently is the effect on the money wage rate W_X in the export sector. As X is a function of W_X, we cannot determine the sign of the effect on X. Variation of X has further repercussions, but as it is unclear which way X is affected, the signs of the repercussions are also unclear. Nonetheless, provided condition (A2) is satisfied, we still have that a greater M_Q is associated with higher levels of the food price p_F and production A_F, and with lower levels of food imports A^M and consumption F^d. And, regardless of whether (A2) is satisfied, output of the non-traded industrial good Q is greater and its price p_Q lower. However, since the effects on W_X, P and X are unclear in sign, we conclude that a policy of credit *restriction* of SOEs does not necessarily lead to a lower price level and *may* have indirect effects that limit exports.

The second row of Table 1 shows the effects of a higher nominal interest rate r, a policy that has increasingly been used in China in recent years as part of a policy package to try and hold back inflation (World Bank, 1996). In our model, however, a higher r is associated with a *higher* level of the price index P, indicating that anti-inflationary policy might have been more successful without the interest rate adjustment. Furthermore, whereas the output of non-traded industrial goods Q is unaffected[20] (the binding constraint on Q is the credit plan M_Q, which is unchanged), exports are reduced because of the higher cost of working capital. The higher level of P follows from X being smaller: given the balance of trade constraint B^*, fewer food imports A^M are

allowed in, causing p_F and therefore P to rise. This also causes the nominal wage rate W_X to rise, further depressing X, with repercussions reinforcing those already described. Since p_F/p_Q increases, the utility of food producers rises; but, apart from this, the only effects of a higher nominal interest rate are harmful. This macroeconomic argument may be combined with the microeconomic rationale given by Zou and Sin (1996) for keeping the nominal interest rate low in China.

Thirdly, consider the effects of a monetary expansion in the form of higher initial household money holdings M^o. The initial impact is that the demands for the two domestically-consumed goods rise in equal proportions, as, therefore, do the prices p_F and p_Q. Hence, P and W_X also rise, and, because of the latter, X is reduced. There is then less foreign exchange available for food imports, which are reduced. This gives a further stimulus to p_F, so that the terms of trade p_F/p_Q rises, causing some increase in domestic food output A_F, though, given the satisfaction of the stability condition (A1), this output increase is less than the amount by which food imports fall. Thus, as Q is unaffected (since M_Q is constant), the greater money supply is associated with *lower* domestic consumption. A rise in the budget deficit D, through a reduction in lump-sum taxes T, has the same qualitative effects.

Part of the interest in examining the effects of a higher level of M^o is that this also reveals the effects of a higher level of the 'financial discipline' (or 'budget hardness') parameter ö. When ö is greater, firms in the non-traded industrial good sector pay banks a larger proportion of what they owe them. One effect is on the budget deficit D (see eq.(21)), but, by assumption, the authorities respond by setting higher taxes T to maintain D. Also, however, when ö is greater, workers in this sector are paid a smaller amount, W_Q per head, *ceteris paribus*. The macroeconomic effects are qualitatively the same as those of a *reduction* in M^o.[21] Hence, the effects described in the previous paragraph again apply, but in reverse. Among the benefits of making budget constraints harder are that exports and food consumption rise and that the

aggregate price level is reduced. However, since p_F/p_Q declines, food producers suffer a fall in utility.[22]

The next parameter change shown in Table 1 is an increase in the exchange rate *e*, i.e., devaluation, a policy that China used in 1994, but is currently reluctant to use again, given the financial fragility of the region and concerns about the implications for the Hong Kong dollar (Economist, 1998). The higher level of e has two immediate effects. One is that exports X rise. The other is that, since M_Q is constant, but p_I increases, SOEs can buy fewer intermediates I_Q, and therefore their output Q falls and the price p_Q rises. These effects improve the balance of trade in foreign currency and so more food imports are allowed in, with a negative effect on the food price p_F. However, with p_Q and p_F affected in opposite directions, the consequences for the aggregate price level P, and therefore for the nominal wage rate W_X are unclear. As a result, the further repercussions on exports X are unclear in sign. Nonetheless, it is found that if (A2) is satisfied the overall effects on food imports and food consumption remain positive, while domestic food output falls.

To summarize, we have found that for the three sectors in our model, devaluation is either contractionary or may be contractionary. There are two reasons for this, each associated with government constraints on market behaviour. The first is because of the control of food imports. It is well known that if, as part of a policy package, import controls are relaxed when devaluation occurs, the resulting inflow of imports can be harmful to domestic producers of the good concerned (see Cooper, 1971). The second is because of the role of the credit plan and is specific to China. With credit for SOEs fixed in domestic currency terms, devaluation raises the domestic currency price of inputs and so forces SOEs to reduce their output.[23] We conclude that it may not be to China's disadvantage that regional considerations constrain its policy.[24]

For completeness, the effects of exogenous increases in each of the foreign currency prices p_I^*, p_X^* and p_F^* are shown in the last three rows of Table 1. Briefly, when p_X^* is higher or p_I^*

lower, exports rise, so that more food imports are allowed in. It is straightforward to trace through the various repercussions. Whereas, for example, a higher p_X^* has no effect on Q, a lower p_I^* allows the non-traded industrial good sector to buy more intermediates with its given credit plan M_Q, so that Q rises. The effects of a higher foreign currency price of food, p_F^*, as shown in the last row of the table, are the same in sign as those of a higher balance of trade requirement B^*. In each case food imports A^M decline, so that the food price p_F rises. Although this stimulates food production, it also raises the price index P. The money wage rate W_X therefore rises, causing exports X to decline. Thus, a higher balance of trade requirement leads to a decline in exports.

4. CREDIT RATIONING IN THE EXPORT SECTOR

We have already mentioned in the introduction that during some more severe inflationary episodes the authorities have subordinated all other objectives to containing inflation, with credit rationing extended to the more dynamic sectors of the economy. In terms of our model, the representative exporting firm then faces a binding credit plan. This requires only minor amendments to our set-up. All equations in Section 2 still hold, except that M_X is now interpreted as exogenous and, instead of (16), we have

$$L_X = (M_X/p_I)^{\frac{1}{b}} \tag{16'}$$

The exporting firm only takes on the amount of labour that can usefully be combined with intermediates, and its purchase of intermediates is determined by the credit plan: $p_I I_X = M_X$. Equilibrium condition (26) no longer applies. To solve the macroeconomic system now we simply use (24) and (25) to determine p_F and p_Q. The values of all other variables either follow recursively or are independently determined. For brevity, we consider here only the three main amendments that are then required in the comparative statics.[25]

First, there is now an additional policy parameter, M_X, in the model. The comparative

statics of variation of M_X are shown in the first row of Table 2. A higher level of M_X enables X to be greater. This brings in more foreign exchange, so that food imports A^M are allowed to rise.

[TABLE 2 ABOUT HERE]

The consequent negative impact on the food price p_F causes food production A^F to fall; and since p_Q (and Q), are unaffected, the price index P and the money wage rate W_X also fall. Hence a policy of *tightening* credit to exporters, in order to hold back the aggregate price, is mistaken. Not only does it have the obvious effect of reducing exports, it also has a *positive* effect on the aggregate price level. A related policy change is shown in the second row of the table. As explained in the Introduction, the authorities in China have sometimes switched credit to SOEs from other firms to keep the SOEs afloat. We represent this in the model by writing $\mu \equiv M_Q/(M_Q+M_X)$ and consider the effect of variation of μ for a given $M_Q + M_X$. The rationale for the results in this case has already been given for variations in M_Q and M_X considered separately. Not surprisingly, an increase in μ causes Q and X to fall. However, since, as already explained with respect to Table 1, dP/dM_Q is unclear in sign, we cannot sign $dP/d\mu$ without making further restrictions.

Second, as shown in Table 2, the rate of interest r becomes an entirely impotent policy tool. Since X and Q are both constrained by the amount of credit available, the terms on which the credit is provided have no effect. The only other way that r might impinge on the solution to the model is through its role in the budget deficit. However, provided taxation T is always set such that the target budget deficit D is attained, variation of r has no such affect.

Third, the volume of exports X is now insulated from most policy changes. Of the parameters listed in Table 1, the variations only of e and p_I^* have effects on X. Since $X = I_X = M_X/ep_I^*$, d_X/dp_I^* and dX/de are each negative. This is a clear disadvantage of devaluation in the regime under consideration.

5. CONCLUDING COMMENTS

In this paper we have attempted to formulate a macro model of the Chinese economy, taking into account some of the differences between production sectors in China and paying particular attention to monetary policy. In our basic model we find that a tightening of the credit plan has an effect on the aggregate price index that is unclear in sign. Of course, this does not indicate that the policy is necessarily ineffective; but it does suggest that in the Chinese institutional framework such a policy should be used with care. And we find that the extension of binding credit controls to the export sector should be avoided because there is then a clear-cut positive effect on the aggregate price index.

We also find that another commonly used tool of monetary policy in China, interest rate variation, has the opposite of the desired effect. Given the institutional framework of the credit plan, a higher nominal interest rate is associated with a higher aggregate price index (though if credit controls are extended to the export sector, interest rate variation has no significant effects).

Money is not neutral in the model. Consider an increase in the money supply in the form of higher initial money holdings for households. This has the same macroeconomic effects as when an increased allocation of working capital to SOEs is distributed by the SOEs directly to workers, rather than used for buying intermediates. The price index therefore rises, but the effects on outputs are mixed. The output of SOEs is unaffected, whereas exporters produce less and food production rises. We also examine an increase in financial discipline in the form of SOEs honouring a larger proportion of their debt obligations. This has effects that are opposite in sign to those of an increase in initial money holdings by households. Since the aggregate price index therefore falls, this indicates that the hardening of budget constraints is an effective anti-inflationary device. An added bonus, through general equilibrium repercussions, is that exports increase. Devaluation, however, is of rather doubtful benefit in the model. It has an unclear effect on exports and the price index, while causing SOEs to reduce output; and the effect on food

production is likely to be negative.[26] Furthermore, if credit rationing is extended to the export sector, devaluation causes exports to fall.

Finally, notice that a characteristic feature of the model is that policy changes that lower the price index and raise exports tend to reduce welfare in the agricultural sector. (Agricultural welfare is positively related to the terms of trade p_F/p_Q and so also to output A_F.) Since poverty in China is largely concentrated in the agricultural sector (World Bank, 1997) this indicates a significant conflict facing policy-makers.

APPENDIX

The Basic Model

Differentiating (24) - (26) totally we obtain a system of the form

$$\begin{bmatrix} -k_{11} & k_{12} & k_{13} \\ 0 & -k_{22} & 0 \\ -k_{31} & -k_{32} & -k_{33} \end{bmatrix} \begin{bmatrix} dp_F \\ dp_Q \\ d_X \end{bmatrix} = K_z[dz]$$

where the k_{ij}'s are the numerical values of the partial derivatives attached to the endogenous variables dp_F , dp_Q and dX (i.e., $k_{ij}>0 \ \forall \ i \ , \ j$). The rows of the matrix of partial derivatives correspond, respectively, to (24) - (26). On the r.h.s., dz is the column vector of differentials of parameters listed in Table 1; and K_z is the corresponding matrix of partial derivatives.

The determinant of the k_{ij} -matrix is

$$Ä \equiv -k_{11}k_{22}k_{33} + k_{13}k_{31}k_{22} \qquad \text{(A1)}$$

For the stability of the system it is sufficient to assume that $Ä< 0$. The signs in Table 1 that are not in parentheses then follow immediately. For the signs in parentheses we further assume that

$$k_{22}k_{33}/p_F^* - (k_{12}k_{33}+k_{13}k_{32})/p_I^* > 0 \qquad \text{(A2)}$$

Our sign assumptions are essentially that direct partial derivatives dominate indirect partial derivatives.

Credit Rationing in the Export Sector

As explained in the text, the introduction of credit rationing in the export sector enables us to drop eq. (26) from the macro system, which, in differential form becomes

$$\begin{bmatrix} -k_{11} & k_{12} \\ 0 & -k_{22} \end{bmatrix} \begin{bmatrix} dp_F \\ dp_Q \end{bmatrix} = K_z^{/}[dz^{/}]$$

where $K_z^{/}$ and $dz^{/}$ are the appropriately amended forms of K_z and dz, respectively. The corresponding stability condition is

$$Ä^{/} \equiv k_{11}k_{22} > 0 \qquad \text{(A3)}$$

(A3) is satisfied without the need for further assumptions.

NOTES

1 See, e.g. Allsopp (1995) or World Bank (1995).

2 For general discussions of the credit plan see Montes-Negret (1995) and World Bank (1995). State commercial banks have repeatedly found new ways to circumvent the credit plan by disguising their lending, and there has been a steady growth of non-bank financial intermediaries (World Bank, 1996). Nonetheless the credit plan retains its pre-eminent role in monetary policy.

3 A recent official (i.e. conservative) estimate puts the proportion at 22% (Economist, 1997).

4 This three-sector framework is also used in Bennett and Dixon (1996). There, however, we model dual-track pricing and urban goods rationing. Here, we suppress such considerations and elaborate on the monetary side. It is worth noting that urban rationing is now much less prevalent, though it has not disappeared completely (see Gao, Wailes and Cramer, 1996).

5 This is the key constraint that drives the determination of equilibrium for the whole economy in the model. In contrast, in Bennett and Dixon (1996) the critical factor is the availability of imported intermediates, which is limited by the balance of trade constraint.

6 This happened, for example, in early 1996 (see Sachs and Woo, 1997).

7 This formulation is explained in more detail in our earlier paper.

8 According to the World Bank (1997) the main factor limiting migration to towns and cities may be the difficulty migrants have in qualifying for urban welfare facilities. Also, if a household is absent from its village it may lose its chance to be allocated agricultural land.

9 SOEs now produce about 1/3 of industrial output and account for about 2/3 of urban employment (World Bank, 1997).

10 For simplicity, we use the terms 'household' and 'employee' interchangeably. In China family members tend to all work in the same enterprise, so our mixing of the terms may be of little consequence.

11 In practice, more than 95% of industrial output is now sold at market prices (World Bank, 1997).

12 The model might be reformulated on the assumption that ö is endogenous. If the employees of SOEs find that their income W_Q is going to decline, they may be willing to risk greater conflict with the authorities by honouring less of their debt obligation (reducing ö). As a stylized representation of this case, suppose they choose ö so that W_Q always reaches a given target level. For a given value of T_Q it turns out that none of our macroeconomic results are affected by this change to the model. The reason for this is that only income distribution is affected, and, given utility function (1), distributional changes have no effects on the macro equilibrium.

13 In 1995 86% of China's merchandise exports were manufactures (World Bank, 1997, p. 128).

14 Almost half of all Chinese imports are processed to go to export (World Bank, 1996).

15 Because our formulation of the labour market (see below) entails an infinitely elastic labour supply in the relevant region, we need diminishing returns to labour in eq. (13) for there to be a unique employment equilibrium.

16 We might also incorporate joint ventures with foreign companies into the model by assuming that a portion of export sector profit goes to foreigners. This would introduce various indeterminacies into our results because exports and profit outflows would be positively related, having conflicting effects on foreign currency flows and therefore having repercussions that are unclear in sign.

17 Currently, China imports about 5% of its grain needs (World Bank, 1997).

18 Here, and throughout, we economize on notation by writing aggregate variables for the two industrial sectors as if there were only one firm in each sector.

19 It might also appear that the losses of the SOE-sector should be added into (22). However, allowing for the possible non-payment of some debt, the SOE-sector breaks even by definition because all surplus is distributed to workers.

20 Since Q is constant, so too is p_Q. This is because with utility function (1) domestic demands are isoelastic in own price (see (23)).

21 Conversely, as was noted in Section 3, when part of M_Q is distributed directly to workers (instead of being used to buy intermediates) W_Q is thereby increased. The macroeconomic effects are qualitatively the same as those of an increase in M^o.

22 If T is held constant when ö increases, D is fixed at a lower level. As we have already seen, this has the same qualitative effects as a fall in M_o does.

23 A corresponding effect in a market economy is that devaluation may force up the interest rate because it reduces the real volume of credit. The interest rate rise then has contractionary effects (see van Wijnbergen, 1986).

24 Empirical evidence on the effects of Chinese devaluations is contradictory: see Brada, Kutan and Zhou (1993) and Turay (1995). In our earlier model (Bennett and Dixon, 1995) we did not allow for credit controls or food imports and so are found that devaluation was expansionary.

25 In the comparative statics of the reformulated model there are no signs that are the reverse of those shown in Table 1.

26 In contrast, in our 1996 paper we found that devaluation reduces price variables and increases quantity variables. However, that paper was concerned primarily with fiscal matters. It did not take into account the critical roles played by the credit plan and working capital in the Chinese economy.

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parameters	endogenous variables							
	p_F	p_Q	W_X, P	X	Q	A^M	A_F	F^d
M_Q	(+)	-	?	?	+	(-)	(+)	(-)
r	+	0	+	-	0	-	+	-
M^o,D	+	+	+	-	0	-	+	-
ö	-	-	-	+	0	-	-	+
e	(-)	+	?	?	-	(+)	(-)	(+)
p_X^*	-	0	-	+	0	+	-	+
p_I^*	+	+	+	-	-	-	?	-
p_F^*,B^*	+	0	+	-	0	-	+	-

Table 1: Comparative Statics

parameters	endogenous variables							
	p_F	p_Q	W_X,P	X	Q	A^M	A_F	F^d
M_X	-	0	-	+	0	+	-	+
μ	?	-	?	-	0	-	?	?
r	0	0	0	0	0	0	0	0

Table 2: Modification of the Credit Plan